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Recent progress of graphene oxide as a potential vaccine carrier and adjuvant

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Abstract

Vaccine is one of the most effective strategies for preventing and controlling infectious diseases and some noninfectious diseases, especially cancers. Adjuvants and carriers have been appropriately added to the vaccine formulation to improve the immunogenicity of the antigen and induce long-lasting immunity. However, there is an urgent need to develop new all-purpose adjuvants because some adjuvants approved for human use have limited functionality. Graphene oxide (GO), widely employed for the delivery of biomolecules, excels in loading and delivering antigen and shows the potentiality of activating the immune system. However, GO aggregates in biological liquid and induces cell death, and it also exhibits poor biosolubility and biocompatibility. To address these limitations, various surface modification protocols have been employed to integrate aqueous compatible substances with GO to effectively improve its biocompatibility. More importantly, these modifications render functionalized-GO with superior properties as both carriers and adjuvants. Herein, the recent progress of physicochemical properties and surface modification strategies of GO for its application as both carriers and adjuvants is reviewed. STATEMENT OF SIGNIFICANCE: Due to its unique physicochemical properties, graphene oxide is widely employed in medicine for purposes of photothermal treatment of cancer, drug delivery, antibacterial therapy, and medical imaging. Our work describes the surface modification of graphene oxide and for the first time summarizes that functionalized graphene oxide serves as a vaccine carrier and shows significant adjuvant activity in activating cellular and humoral immunity. In the future, it is expected to be introduced into vaccine research to improve the efficacy of vaccines.

Keywords: Adjuvant delivery; Antigen delivery; Functionalized-GO; Immune adjuvant; Vaccine adjuvant; Vaccine nano-carrier.

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